research paper series

Globalisation, Productivity and Technology

Research Paper 2003/22

Do Exporters Have Anything to Learn from Foreign Multinationals?

S. Girma, R. Kneller and M. Pisu

The Centre acknowledges financial support from The Leverhulme Trust under Programme Grant F114/BF

Leverhulme Centre
for Research on Globalisation and Economic Policy

The Authors

Sourafel Girma is a Lecturer at the University of Leicester; Richard Kneller is Research Fellow in GEP, University of Nottingham; and Mauro Pisu is a Research Associate in GEP, University of Nottingham.

Acknowledgements

R. Kneller and M. Pisu are grateful to The Leverhulme Trust for financial support under Programme Grant F114/BF.

DO EXPORTERS HAVE ANYTHING TO LEARN FROM FOREIGN MULTINATIONALS?

Sourafel Girma, Richard Kneller and Mauro Pisu

Abstract:
Using recent data on propensity-score matched firms from the U.K manufacturing industry, the paper uncovers evidence that acquisition FDI is an important channel of direct technology transfer from foreign multinationals to domestic exporters. This is consistent with the recently developed theory by Helpman, Melitz and Yeaple (2002) which, because of sunk costs, predicts firms engaged in FDI activity are more productive than those serving foreign markets through arms-length exporting. This finding also lends support to policy makers' intervention to attract inward investment, often with the use of substantially more public funds than are devoted to encouraging domestic firms to export.

Keywords: Exports, Foreign acquisition, Productivity.

JEL classifications; D24, F14, F23.

Outline

1. *Introduction*
2. *The productivity of MNEs and of exporting firms*
3. *Empirical methodology*
4. *Description of the data*
5. *Empirical Results*
6. *Conclusions*

Non Technical Summary:

A number of recent theoretical models have identified international trade (exporting and importing) and foreign direct investment as the main channels for the international transfer of new technology and ideas. This paper adds to our understanding of these mechanisms by considering the relative importance of these channels. Testing for the presence of technology transfer from foreign multinational firms to firms already engaged in exporting is one way of gaining insights that may inform future theoretical works.

The policy importance of analysing the extent of technology transfer from multinationals to domestic exporters should also be emphasised. Governments the world over intervene to attract foreign direct investment by offering incentives such as trade policy concessions, financial assistance, and tax breaks to multinational firms. Policy makers are also involved in variegated export promotion activities, stretching from trade promotion schemes to export subsides. However, incentives to attract foreign multinational firms generally make use of substantially more public resources than are devoted to the promotion of exports. In order to design cost effective policies it is important to investigate whether domestic firms capture significant productivity gains from multinational enterprises *over and above* those that might be obtained through learning-by-exporting alone.

The empirical setting of the paper is the U.K manufacturing industry. The UK is the second largest host to FDI after the USA, and the fifth largest exporter of merchandise exports globally. Secondly, over 80 per cent of all foreign acquisitions that occur during our sample period (1988-1996) are of domestic firms that have at least some export experience. Finally, in common with many developed economies, foreign acquisitions are by far the most important component of aggregate FDI flows into the U.K.

Two possible explanations might be given as to why foreign firms target export firms. Firstly, foreign firms may use information about export status to provide information about the productivity of the firm. Alternatively, overseas buyers might prefer firms with some foreign experience since they are likely to be more "similar" to themselves and therefore incur fewer and smaller post-acquisition costs related to the assimilation of the recently incorporated firm. Either way, this complicates the task of evaluating the distinctive productivity effects of international acquisitions. To circumspect this selection problem, we draw on the microeconometric evaluation literature and employ propensity score-matching techniques. The basic idea of matching in the present context is to select from the reservoir of exporting firms that remain domestically owned, those firms that are as similar as possible to those acquired by foreign MNEs. This would allow the construction of a valid comparison group, and thus a more accurate measurement of the causal effects of acquisition FDI. From this we find strong evidence that the performance of acquired firms improves significantly after they are acquired. Foreign multinational firms bring to export firms further advantages that improves the performance of these firms still further.

1. Introduction

Do domestic exporters learn from their association with foreign multinationals? This is the main question addressed by this paper, and there are both theoretical and practical reasons for taking this topic seriously.

While a number of endogenous growth models identify international trade (exporting and importing) and foreign direct investment as the main channels for international technological transfer (see Keller, 2001, for an excellent review of the literature), the issue of assessing the relative importance of these channels seems to have been given less attention. Yet it is important to do so for a deeper understanding of the mechanisms of technology transfer. Testing for the presence of technology transfer from foreign multinational firms to firms already engaged in exporting is one way of gaining insights that may inform future theoretical works. Furthermore, determining the existence of economically significant productivity spillovers from multinational enterprises (MNEs) to firms engaged in exporting provides a test for the Helpman, Melitz & Yeaple (2003) model. This model predicts that because of the existence of sunk costs, firms engaged in FDI activity are more productive than those serving foreign markets through arms-length exporting alone.

The policy importance of analysing the extent of technology transfer from multinationals to domestic exporters should also be emphasised. Governments the world over intervene to attract foreign direct investment by offering incentives such as trade policy concessions, financial assistance, and tax breaks to multinational firms (see Blomström and Kokko, 2003 for a recent discussion). Policy makers are also involved in variegated export promotion activities, stretching from trade promotion schemes to export subsides. However, incentives to attract foreign multinational firms generally make use of substantially more public resources than are devoted to the promotion of exports.[1] In order to design cost effective policies it is important to investigate whether domestic firms capture significant productivity gains from multinational enterprises *over and above* those that might be obtained through learning-by-exporting alone.

[1] For example, the U.K. government has paid about a billion pounds paid in grants for internationally owned companies alone between 1991 and 1995, costing around £17, 500 per net job created (see the official report available at http://www.dti.gov.uk/regional/evaluationRSA91-95.pdf)

The empirical setting of the paper is the U.K manufacturing industry, which provides a good test case for this work. Firstly, the UK is the second largest host to FDI after the USA,[2] and the fifth largest exporter of merchandise exports globally. Secondly, over 80 per cent of all foreign acquisitions that occur during our sample period (1988-1996) are of domestic firms that have at least some export experience. We find that domestic firms with established export experience are between 55% and 77% more likely to be acquired than firms with no export experience.[3] Finally, in common with many developed economies, foreign acquisitions are by far the most important component of aggregate FDI flows into the U.K.

Two possible explanations might be given as to why foreign firms target export firms. Firstly, if the productivity of the firms is unobservable or observed only with error, then foreign firms are likely to use information of productivity provided by other observable characteristics of the firm. One indicator that might be useful in this regard is the export status. Empirical studies have overwhelmingly corroborated the hypothesis that export firms are more productive than non-export firms (e.g. Bernard and Jensen, 1999; Girma, Greenaway and Kneller, 2002). Alternatively, overseas buyers might prefer firms with some foreign experience since they are likely to be more "similar" to themselves and therefore incur fewer and smaller post-acquisition costs related to the assimilation of the recently incorporated firm. Either way, this complicates the task of evaluating the distinctive productivity effects of international acquisitions. To circumspect this selection problem, we draw on the microeconometric evaluation literature[4] and employ propensity score-matching techniques due to Rosenbaum and Rubin (1983). The basic idea of matching in the present context is to select from the reservoir of exporting firms that remain domestically owned, those firms whose distributions of the variables affecting productivity (e.g. export intensity and size) are as similar as possible to those acquired by foreign

---

[2] The UK has a total of $400bn of direct foreign investment, and attracted $78bn in 1999 according to the United Nations Conference on Trade and Development. It is estimated that more than one-third of the UK's manufacturing sector is now foreign owned. The UK is home to over 22% of all foreign direct investment in the EU. This includes over 40% of both US and Japanese investment.

[3] This is based on some preliminary data analysis we conducted. Details are available upon request.

[4] For a comprehensive review on the microeconometric evaluation literature see Blundell and Costa Dias (2000). Matching techniques are especially popular in applied labour economics, where, for example, the aim of the study is the evaluation of training programmes on earnings.

MNEs. This would allow the construction of a valid comparison group, and thus a more accurate measurement of the causal effects of acquisition FDI on firm performance. From this we infer the relative contribution of exporting and FDI to technology transfer at the firm level.

The rest of the paper is organised as follows. Section 2 gives an outline of the theoretical justifications and empirical evidence concerning the high level of productivity of MNEs and exporting firms and tries to discern what type of domestic firms are more likely to be acquired by foreigners. Section 3 discusses the empirical methodology, and Section 4 describes the database used in this exercise. Section 5 presents the empirical results. Finally Section 6 concludes.

2. The productivity of MNEs and of exporting firms

In the literature concerning exporting and FDI at the firm level there is a general consensus that exporting firms and MNEs enjoy relatively high levels of productivity compared to domestic non-exporting firms and non-MNEs respectively. Sunk costs related to export market entry or becoming multinational and the cost of operating plants in foreign countries play a crucial role in explaining these efficiency differences in both literatures. Only those firms having specific tangible or intangible advantages, which result in higher levels of efficiency, can overcome the sunk-costs and therefore profit from servicing domestic and foreign markets (through exports or FDI).

With reference to the export literature, sunk costs of entry may include market research, product modifications, compliance with different regulations and legal systems and so on. A profit maximising firm will decide to start exporting only if the present value of its profits is higher than the sunk cost of entry. Thus, the most productive companies self-select into export markets. Theoretical models of Clerides, Lach and Tybout (1998) and Bernard and Jensen (2001) posit this sort of behaviour. This prediction has been corroborated by numerous empirical findings for different countries (e.g.: Bernard and Jensen (1999) for US; Delgado *et al.* (2001) for Spain; Bernard and Wagner (1997) for Germany; Castellani (2002) for Italy).

Recently, Girma *et al* (2002) provide empirical evidence supporting the complementary idea of learning by exporting for UK firms. Exposure to best practice and to greater competition leads to productivity improvements within export market entrants.

The most efficient firms start exporting and as a consequence become even more productive.

Theories of FDI emphasise similar assumptions: MNE's have inherent firm-specific advantages allowing them to overcome the higher costs of operating plants in more than one country (Hymer, 1976; Kindleberger, 1969). These advantages over domestically owned firms may be tangible, for instance an improved production process, product innovation or wider international distribution networks, or intangible, such as brand name, better management structures or human capital embodied in employees (Kogut, 1985; Grant, 1987; Gomes and Ramaswamey, 1999). Foreign firms are likely to merge or to acquire domestic firms (also referred to as brownfield FDI) if the returns to these assets are expected to be large or if there is an under-exploited asset within the domestic firm (Markusen 1995; Dunning, 1993).

The type of domestic firms foreign MNEs acquire is likely to depend on the sunk costs that are involved in this process. These sunk costs take two forms: pre-acquisition and post acquisition sunk costs. The former relates to the costs of entry, the search for suitable targets, evaluating these targets and negotiating with owners and other parties about acquisition (Balakrishnan and Korza, 1993). The latter relate to establishing trust in the acquired firm and it employees and the assimilation into the organisation of the parent company through the adoption of new technology and other organisational changes (Buckely and Casson 1998; Harris and Robinson 2002).

These two types of sunk costs may have different effects. Sunk costs of entry are likely to affect the choice of a firm to serve foreign markets either through exporting or through establishing plants therein, as shown by Helpman *et al.* (2003). Only the most productive firms within an economy find it profitable to meet the higher costs associated with FDI; the next set of firms find it profitable to serve foreign markets through exporting; while the least productive firms find it profitable to serve only the domestic market. Post-acquisition sunk costs are more likely to influence the type of firms that will be acquired (if brownfield investment is chosen). If these costs are large MNEs will attempt to minimise them by targeting indigenous plants with higher than average productivity levels, with technology similar to their own and/or with international experience. If they are not large then under-performing plants (because of the cheap price) will be more likely to be acquired.

Empirical studies of brownfield FDI (e.g. Conyon *et al*., 2002 and Harris and Robinson, 2002) report that foreign MNEs tend to acquire domestic firms with above average performance characteristics. These studies also report evidence of substantial productivity gains due to acquisition FDI. It is possible these studies overstate the productivity improvements however. The propensity of MNE's to acquire higher productivity domestic firms (i.e. exporters) is incompletely controlled for, such that the ownership change effect may erroneously conflate genuine induced productivity growth with some selection bias. This highlights the importance of the construction of a valid comparison (control) group when making a causal inference of the extent of technology transfer from foreign multinationals to domestic enterprises. In the next section we describe how this issue is addressed in this paper.

3. Empirical methodology

The modelling problem is the evaluation of the causal effect of foreign acquisition on y, where y represents total productivity growth. Let $ACQ_{it} \in \{0,1\}$ be an indicator of whether domestic exports firm *i* is acquired by a foreign establishment at time period *t*, and let y^1_{it+s} be the productivity growth at time t+s, $s \geq 0$, following acquisition. Also denote by y^0_{it+s} the productivity growth of the firm *had it not been acquired*. The causal effect of foreign ownership for firm *i* at time period *t + s* is defined as:

$$y^1_{it+s} - y^0_{it+s} \ . \qquad (1)$$

The fundamental problem of causal inference is that the quantity y^0_{it+s} is unobservable. Thus the analysis can be viewed as confronting a missing-data problem. Following the microeconometric evaluation literature (e.g. Heckman et al, 1997), we define the *average* effect of acquisition on the acquired firms as

$$E\left\{y^1_{t+s} - y^0_{t+s} \mid ACQ_{it} = 1\right\} = E\left\{y^1_{t+s} \mid ACQ_{it} = 1\right\} - E\left\{y^0_{t+s} \mid ACQ_{it} = 1\right\} \qquad (2)$$

Casual inference relies on the construction of the counterfactual for the last term in equation (2), which is the outcome the acquired firms would have experienced, on average, had they not been acquired. This is estimated by the average productivity growth of the firms that remained in domestic hands: $E\left\{y^0_{it+s} \mid ACQ_{it} = 0\right\}$.

An important feature in this exercise is the selection of a valid control group. One way of doing so is by employing matching techniques. The purpose of matching is to pair each foreign acquired firm with a domestic firm that has not undergone any ownership change on the basis of some observable variables, in such a way that the control firms' productivity trajectories can be studied to generate the counterfactual for the newly foreign owned firm.

Since matching involves comparing acquired and non-acquired firms across a number of observable pre-acquisition characteristics (e.g. productivity, wage, size, exporting history), it would be difficult to determine along which dimension to match the firms, or what type of weighing scheme to use. It is therefore desirable to perform the matching on the basis of a single index that captures all the information from those variables. In this paper we adopt the method of propensity score matching due to Rosenbaum and Rubin (1983), which suggests the use of the probability of receiving treatment (foreign acquisition in the present context) conditional on those characteristics, to reduce the dimensionality problem. Accordingly, we first identify the probability of being acquired (or 'propensity score') using the following probit model

$$P(ACQ_{it}=1)=F(TFP_{it-1}, size_{it-1}, wages_{it-1}, \exp int_{it-1}, industry\ dummies) \qquad (3)$$

where determinants of acquisition are motivated by the existing literature as discussed in the previous section. Now let P_{it} denote the predicted probability of being acquired at time t for firm i (which is an actual take-over target). A non-acquired firm j, which is 'closest' in terms of its 'propensity score' to an acquired firm, is then selected as a match for the latter using the 'caliper' matching method.[5] More formally, *at each point in time*[6] and for each newly acquired firm i, a domestic firm j is selected such that[7]

$$\lambda > \left|P_{it}-P_{jt}\right| = \min_{k\in\{domestic\}}\{|P_i-P_j|\} \qquad (4)$$

[5] The matching is performed in Stata Version 7 using the software provided by Sianesi (2001).

[6] Note that the matching strategy is only appropriate on a cross-section by cross-section basis. Once the matched firms are identified, we pool all observations on them to form a panel data of matched firms. This panel is used in subsequent analyses.

[7] A non-acquired g firm can be match to more than one exporting firms. By the same token it can happen that an acquired firm may not have a match.

where λ is a pre-specified scalar. This type of matching procedure is preferable to randomly or indiscriminately choosing the comparison group, because it is less likely to induce estimation bias by picking firms with markedly different characteristics.

Having constructed the comparison group (C) of firms that are similar to the acquired firms (A), a standard matching estimator of the causal effect of foreign acquisition can be written as

$$\delta = \sum_{i \in A} \left(y_i - \sum_{j \in C} w_{ij}\, y_i \right) \tag{5}$$

where the w_{ij} are the weights placed on the comparison firm j, generated by the matching algorithm. But this paper employs the more general difference-in-differences estimator on the matched firms to isolate the role of foreign acquisitions in the performance dynamics of firms. This is motivated by recent studies which argue that standard matching estimators are usually unsatisfactory, but in combination with difference-in-differences methodology can have the potential to "...improve the quality of non-experimental evaluation results significantly" (Blundell and Costa Mias, 2000, p. 438).

The version of the combined matching and difference-in-differences estimator we use can be described as follows. Firstly, the difference between the average productivity before and after the change of ownership, say $\Delta^a y$, is calculated. Then this difference is further differenced with respect to the before and after difference for the comparison control group, say Δy^c, to obtain the difference-in-differences estimator $\delta = \Delta^a y - \Delta^c y$. Defining PACQ as a dummy variable for the post-acquisition period, the regression

$$y_{it} = \phi + \delta PACQq_{it} + u_{it} \tag{6}$$

should produce a coefficient δ that can be interpreted as the average change in y that can be attributed to foreign acquisitions. In order to control for possible observable factors that may be correlated with changes in total factor productivity growth, we extend this basic framework by including a vector of regressors which consists of twice lagged change in log of *domestic* market shares (*DMSHR*) in the industry,[8] change in industrial competition (*HERFIND*) and industry growth (*INDGROW*). It is expected that firms in industries with

[8] Throughout we are considering 82 three-digit industries according to the 1992 SIC classification.

lower competition or lower growth would experience lower TFP growth. On the other hand, Nickel (1996) argues that a higher market share conditional on industry competition might signal the absence of a strong competitive pressure on the firm, thus leading to productivity growth slow down. It would be interesting to see if this holds true in our sample of exporting firms that are subject to both domestic and international competitive pressures.

The degree of technology transfer from parent company to new subsidiary is likely to be a function of the acquired firm's existing technological capability, or absorptive capacity (Lapan and Bardhan, 1973). Some threshold level of absorptive capacity or technological congruity might be needed for the acquired firms to fully benefit from their new association with multinationals. But it can also be argued that a domestic exporter that operates nearer the technological frontier might have less to learn from their association with MNEs than otherwise equivalent exports firm. To empirically explore the above conjectures we also interact the post-acquisition dummy variables with pre-acquisition TFP (*PRETFP*). We also include year effects (D_t) to control for macro-shocks and business cycles affecting productivity growth and three-digit industry fixed effects (D_{sic3}). The final estimating equation can then be expressed as,

$$\begin{aligned}\Delta TFP_{it} = {} & \beta_0 + \beta_1 \Delta DMSHR_{it-2} + \beta_2 \Delta HERFIND_{it} + \beta_3 INDGROW_{it} \\ & + \beta_4 PACQq_{it} + \beta_5 PACQ * PRETFP_{it} + D_{sic3} + D_t + u_{it}\end{aligned} \qquad (7)$$

We estimate two versions of Equation (7): OLS with robust standard errors and outlier robust regression (e.g., Rousseeuw and Leroy, 1987) to mitigate the influence of extreme TFP growth rate observations.

4. Description of the data

The data used in the paper is from the *OneSource* database from 1988 to 1996. *OneSource* is one of the few UK firm level data sets to contain information on the export status of the firm. It includes information on all public limited companies, all companies with employees greater than 50, and the top companies based on turnover, net worth, total assets, or shareholders funds (whichever is largest) up to a maximum of 110,000 companies, in both manufacturing and service industries. Companies that are dissolved or

in the process of liquidation are excluded from the *OneSource* sample.[9] In this paper we concentrate on manufacturing firms from this data source.

OneSource provides information on employment, physical capital, output and cost of goods sold in a consistent way both across firms and across time, and nominal aggregates were deflated using five-digit level industry deflators. However, each edition of *OneSource* contains foreign-ownership indicators for the latest year alone, so that it is not possible to identify when a firm became a subsidiary of a foreign multinational. To track the dynamics of ownership, we matched the population of manufacturing firms in the database to a list of U.K. firms acquired by foreign multinationals.[10] Total factor productivity (TFP) levels and growth rates are constructed using the index number (i.e. non-parametric) approach (Caves, *et al,* 1982a,b; Good *et al*, 1997) and has been previously employed amongst others by Aw *et al* (2000) and Delgado *et al* (2001). The principle advantage of using this measure of productivity over alternatives such as the econometric estimation of the production function is that it allows the comparison of productivity growth rates and levels between firms over time. Further information on the construction of TFP using this index can be found in the Appendix.

In Table 1 we report the number and the percentage of domestic companies acquired by foreign multinationals according to the export status of the firm. Specifically, whether the firm has exported in all years of the sample prior to the take-over, whether the firm has entered to or exited from the export market and whether the foreign acquired firms had not any previous export experience in our sample period before being bought. From Table 1 we find that by far the largest number of foreign acquired firms exported throughout the period of the sample, 72 per cent, while an additional 17 per cent had at least some export experience. In the total sample of domestic firms the percentage of exporters is 61.1 per cent, a further 16.3 per cent enter export markets during the sample period, 3.8 per cent of firms stop exporting, while 13.3 per cent of domestic firms never export. The incidence of foreign acquisition of export firms is therefore greater than the incidence of exporting in the population as a whole.

[Table 1 about here]

[9] For this study we used the OneSource CD-ROM entitled "UK companies, Vol. 1", for October 2000.

The data were then screened to select those manufacturing firms for which there are a complete set of information about the value of output and factors of production. Since the purpose of this paper is to isolate the productivity gains that accrue from FDI over and above those that result from learning by exporting alone, firms with no exporting experience during the decade spanning our sample are ruled out from the analysis. This left a total sample of 23,412 observations containing information of some 4,100 firms, including 374 foreign acquired firms. More than 50% of these firms are observed for 6 or more years. The propensity-score matching process was conducted on this reduced sample. Table 2 describes the frequency distribution of foreign acquisition by year for both unmatched and matched samples. Of the 374 exporting firms acquired by foreign firms, 373 attain a suitable match that falls within the specified calliper.

[Table 2 about here]

Table 3 contains basic sample statistics for our data. The consequence of the matching process may also be observed. The population of the potential comparison group consists of 3,726 non-acquired exporting domestically owned firms, 300 of which were found to be good matches for the 373 foreign acquired firms.[11] The difference between the selected control and the population of non-acquired firms may be seen in Table 3, as may the similarity in characteristics of the control and acquired group in the matched sample. Firms subject to acquisition are larger, both in terms of output and employment, as well as having higher levels of productivity and export intensity than the population.

[Table 3 about here]

5. Empirical Results

Table 4 shows the results from the matched difference-in-difference regressions for the post acquisition performance of export firms across a number of econometric specifications. From the results presented in column 1 of the Table we find that total factor productivity growth depends on a number of observable industry characteristics. TFP growth is lower the higher the (three-digit) industry concentration in the industry, and is

---

[10] This information which is in hard copy format is obtained from the Office of National Statistics upon special request. The matching process required considerable effort, and we wish to thank Mehtap Hisarciklilar for help in this regard.

[11] Notice the propensity score-matching method replaces matched firms into the sample. One control firm can therefore pair with more than one acquired firms.

higher in expanding compared to contracting industries. Domestic market shares are not found to exert any negative effect on productivity growth trajectory, *ceteris paribus*. This contrasts with Nickell (1996), also for a sample of U.K companies. This difference in results may be because our sample consists of exporters that are facing both domestic and international competition, so that higher domestic market shares (and hence less domestic competitive pressures) do not necessarily lead to productivity slowdown. It is also worth mentioning that the calculation of domestic market shares in Nickell (1996) did not, to the best of our knowledge, take account of exports either at firm or at the industry level. Overall, these results suggest that controlling for differing industry characteristics when analysing the causal effect of ownership change on post-acquisition productivity growth is important.

[Table 4 about here]

Turning our discussion to the causal impact of acquisition FDI. It can be seen from column 1 that foreign acquisition led to a significant increase in the average productivity growth amongst erstwhile domestic establishments. TFP growth is an estimated 1.5 per cent per annum higher in acquired export firms compared to non-acquired export firms. This coefficient is statistically significant at conventional levels.

In column 2 we consider whether these results for acquisition are generated by the exclusion of other fixed industry factors, while columns 3 and 4 consider their robustness to the exclusion of influential outliers from the sample.

While, as expected, there is some sensitivity of the measured industry effects to the inclusion of the industry fixed effects, the results for foreign acquisition are robust to these changes. This finding accords with the prediction of the internalisation theory of FDI which postulates that multinational firms transfer a range of intangible proprietary assets to their affiliates (e.g. Caves, 1996). The magnitude of these efficiency gains are economically significant, and range from 0.8 percentage points (column 4) to 1.6 percentage points (column 2) in the yearly TFP growth rates. The sizes of these effects are notable given the high pre-acquisition productivity of these acquired firms.

We explore these results further in Table 5 by considering the distribution of technology transfer across new foreign owned firms. To measure these effects we interact the post acquisition indicator with the pre-acquisition TFP level of the firm.

[Table 5 about here]

Once we control for differences in the position of the steady state across industries through the inclusion of industry fixed effects, it would appear that the rate of learning from the parent company is more pronounced the lower the pre-acquisition TFP level of the new subsidiary. The term on the initial TFP variable is negative and significant in columns 2 and 4. We infer from this that foreign acquired firms are converging in their TFP levels to foreign multinational firms. Figure 1, based on the results in the column 2 of Table 5, summarises the effects of learning graphically. The median effect on TFP growth is 1.4 percentage points. We estimate from the raw data that only 8% of the acquired export firms experienced negative productivity shocks following their association with foreign multinationals. In summary, there is robust statistical evidence that foreign acquisition has strong positive effects on acquired firms.

[Figure 1 about here]

6. Conclusion

This paper concentrates its efforts on isolating the causal productivity impact of international acquisitions on domestic exporters. Our analysis indicates that acquisition FDI is generally efficiency promoting, and this conclusion is robust to a number changes in the econometric specification. This is very much in line with the traditional internalisation theory of FDI which postulates that multinational firms transfer a range of intangible proprietary assets to their affiliates. This paper also offers fresh empirical support to the recent Helpman, Melitz and Yeaple (2003) model in which, because of sunk costs, predicts firms engaged in FDI activity are more productive than those serving foreign markets through arms-length exporting alone. As might be expected the size of these efficiency gains varies across firms, where the size of this effect depends on the scope for productivity catch-up. At the median TFP growth in acquired firms is 1.4 percentage points faster than non-acquired firms with similar pre-acquisition characteristics. The TFP effect of acquisition is greater the lower the initial TFP of the acquired firm. This is an economically important magnitude, especially in view of the fact that export firms operate at efficiency levels above the general populous. The matching procedure we employed justifies the interpretation of these productivity gains as ones that would not have occurred through learning-by-exporting alone.

Thus our findings provide suggestive evidence that FDI is perhaps a more important vehicle of international technology transfer than exporting. They also lend support to policy makers' intervention to attract inward investment, often with the use of substantially more

public funds than are devoted to encouraging domestic firms to export. However, the task of evaluating the overall effectiveness of foreign direct investment incentives is likely to be more onerous and also we do not judge whether the mix of expenditures on these policy interventions is optimal. We leave these to future work.

References

Aw, B.Y., Chung S., and M.J. Roberts (2000): "Productivity and Turnover in the Export Market: Micro-level Evidence from the Republic of Korea and Taiwan (China)", *The World Bank Economic Review*, Vol. 14. No. 1, pp.65-90.

Balakrishnan S. and Korza M.,1993, 'Information Asymmetry, Adverse selection and Joint Ventures: Theory and Evidence', *Journal of Economic Behavior and Organization*, 20, 99-117.

Bernard, A. and Jensen, J.B. (1999), Exceptional exporters performance: cause, effect or both?, *Journal of International Economics*, *Vol. 47, pp.1-25.*

Bernard, A. and Jensen, J. (2001) ' Why Some Firms Export', NBER Working Paper No. 8349.

Bernard, A. and Wagner, J. (1997), Exports and success in German manufacturing, *Weltwirtschaftliches Archiv*, Vol. 133, pp.134-157.

Blomström, M and Kokko, A (2003), " The Economics of Foreign Direct Investment Incentives", NBER Working Paper #9489 (ITI);

Blundell, R. and Costa Dias, M (2000). 'Evaluation methods for non-experimental data', *Fiscal Studies,* Vol. 21, pp. 427-468.

Buckley P J, Casson M (1998), 'Models of the Multinational Enterprise', *Journal of International Business Studies*, pp.21-440

Castellani, D. (2002), Export Behaviour and Productivity Growth: Evidence from Italian Manufacturing Firms, *Weltwirtschaftliches Archiv*, Vol. 138, pp.605-628.

Caves, R.E. (1996). *Multinational Enterprise and Economic Analysis*. Second Edition. Cambridge: Cambridge University Press.

Caves, D. W., Christensen, L. R, and W. E. Diewert (1982a), "Multilateral Comparisons of Output, Input, and Productivity Using Superlative Index Numbers" *The Economic Journal*, Vol. 92, No. 365, pp. 73-86.

Caves, D. W., Christensen, L. R, and W. E. Diewert (1982b), "The Economic Theory of Index Number and the Measurement of Input, Output and Productivity", *Econometrica*, Vol. 50, No 6, pp. 1393-1414.

Clerides, S., Lach, S. and Tybout, J. (1998). 'Is learning by exporting important? Micro-dynamic evidence from Columbia, Mexico and Morocco', *Quarterly Journal of Economics*, 113, 903-948.

Conyon, M.J., Girma, S., Thompson, S. and Wright, P.W (2002). The productivity and wage effects of foreign acquisition in the United Kingdom. *Journal of Industrial Economics*, L , 85-102.

Delgado, M. A., Farinas, J. C., and Sonia Ruano (2001), "Firm productivity and export markets: a non-parametric approach", *Journal of International Economics*, Volume 57, Issue 2, pp. 397-422.

Dunning, J. H. (1993) *Multinational Enterprises and the Global Economy*, Addison-Wesley: Wokingham.

Hymer, S.H. (1976) . *The International Operations of National Firms: A Study of Direct Foreign Investment.* Boston: MIT press.

Kindleberger, C.P. (1969). *American Business Abroad: Six Lectures on Direct Investment.* New Haven: Yale University Press.

Kogut, B (1985). Designing global strategies: profiting from operational flexibility. *Sloan Management Review*, **26**, 27-38.

Girma, S, Greenaway, D and Kneller, D (2002). 'Does exporting lead to better performance? A microeconometric analysis of matched firms' GEP Working Paper 2002/XX, University of Nottingham.

Gomes, L. and Ramaswamy, K. (1999). An empirical examination of the form of the relationship between multinationality and performance. *Journal of International Business Studies,* **30**, 173-188.

Good, D. H., Nadiri, M. I., and R. C. Sickles (), "Index Number and Factor Demand Approaches to the Estimation of Productivity" in M. Hashem Pesaran and M. R. Wickens, eds, *Handbook of Applied Econometrics*, Vol. 2, Blackwell Publishers.

Grant, R.M (1987). Multinationality and performance among British manufacturing companies. *Journal of International Business Studies,* **18** , 79-89.

Harris, R. and Robinson, C. (2002). The effect of foreign acquisitions on total factor productivity: Plant-level evidence from U.K manufacturing , 1987-1992. *The Review of Economics and Statistics,* **84***, 562-568.*

Heckman, J., Ichimura, H., Smith, J. and Todd, P. (1997). 'Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme', Review of Economic Studies, Vol. 64, pp.605-654.

Helpman, E, Melitz, M.J. and Yeaple, S.R. (2003). 'Export versus FDI', NBER Working Paper 9439.

Keller, Wolfgang (2001). ' International technology diffusion', NBER Working Paper W8583.

Lapan, H. and P. Bardhan (1973) 'Localised technical progress and the transfer of technology and economic development', *Journal of Economic Theory*, 6, pp. 585-95.

Markusen, J.R. (1995), 'Incorporating the Multinational Enterprise into the Theory of International Trade', *Journal of Economic Perspectives* 9 , 169-189.

Nickell, S.(1996),"Competition and Corporate Performance", *Journal of Political Economy* 104, 724-746.

Rosenbaum, P. and Rubin, D.B (1983). 'The central role of the propensity score in observational studies for causal effects', *Biometrika*, Vol. 70, *pp.41*-55.

Rousseeuw, P. J. and A. M. Leroy (1987), *Robust Regression and Outlier Detection*, John Wiley, New York.

Sianesi, B (2001). 'Implementing propensity score matching estimators with Stata' program available at http://fmwww.bc.edu/RePEc/usug2001/psmatch.pdf.

Table 1: Foreign acquisitions by exporting status at year prior to acquisition

Export Status	Number	%
Permanent exporters	336	72.20
Non-exporters	66	14.38
New exporters	40	8.71
Exitors	8	1.74

Note: The percentages do not sum to 100 since firms that start to export and successively stop or do the other way round are excluded from our analysis.

Table 2

Frequency of foreign acquisition of exporting firms

Year	Unmatched sample	Matched sample
1988	20	20
1989	40	40
1990	31	31
1991	54	53
1992	52	52
1993	39	39
1994	57	57

1995	56	56
1996	25	25
Total	374	373

Table 3

Summary statistics for the matched and unmatched sample

Unmatched sample						
	Control group		**Acquired group**			
			Pre-acquisition period		*Post-acquisition period*	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Log TFP	-.0376	.220	-.011	.201	.003	.186
TFP growth	-.001	.157	-.014	.147	.015	.132
Log employment	4.921	1.176	5.089	1.268	5.141	1.317
Log output	9.209	1.273	9.532	1.362	9.746	1.404
Export intensity	.243	.248	.270	.249	.303	.277
Number of firms	3726		374			
Total sample size	20959		2453			
Matched sample						
	Control group		**Acquired group**			
			Pre-acquisition period		*Post-acquisition period*	

	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Log TFP	-.014	.200			.003	.187
TFP growth	-.004.	.153			.015	.132
Log employment	5.061	1.275			5.134	1.320
Log output	9.488	1.389			9.738	1.404
Export intensity	.293	.255			.303	.258
Number of firms	300		373			
Total sample size	2008		2444			

Table 4

The productivity impact of foreign acquisitions

on domestic exporters

Dependent variable: TFP growth

	OLS with robust Standard errors		Outlier robust estimates	
	Without industry effects	With Industry effects	Without industry effects	With Industry effects
	(1)	(2)	(3)	(4)
HERFIND	-0.309	-0.202	-0.172	-0.110
	(2.16)**	(1.13)	(1.93)*	(1.08)
INDGROW	0.117	0.092	0.074	0.047
	(2.58)**	(1.72)*	(3.74)***	(2.18)**
DMSHR	0.001	-0.001	-0.000	-0.001
	(0.07)	(0.15)	(0.02)	(0.19)
PACQ	**0.015**	**0.016**	**0.010**	**0.008**
	(3.28)* **	**(3.29)*** **	**(2.66)*** **	**(2.10)** **
Constant	-0.079	-0.028	-0.076	-0.078
	(4.80)***	(2.22)**	(12.02)***	(2.71)***
Observations	2314	2314	2314	2314
R-squared	0.05	0.08	0.11	0.17

Notes:

(i) Heteroskedasticity and serial correlation robust t-statistics in parentheses

(ii) * significant at 10%; ** significant at 5%; *** significant at1%

(iii) All specifications include year dummies

(iv) The number of observations used in the regression is less than the total available observations because of the lagging and differencing of the variables

Table 5

Productivity impact of foreign acquisitions and pre-acquisition levels of TFP

Dependent variable: TFP growth

	OLS with robust Standard errors		Outlier robust estimates	
	Without industry effects	With Industry effects	Without industry effects	With Industry effects
	(1)	(2)	(3)	(4)
HERFIND	-0.308	-0.194	-0.170	-0.106
	(2.16)**	(1.08)	(1.91)*	(1.03)
INDGROW	0.116	0.089	0.074	0.047
	(2.54)**	(1.65)*	(3.73)***	(2.16)**
DMSHR	0.001	-0.001	0.000	-0.001
	(0.08)	(0.14)	(0.01)	(0.13)
PACQ	**0.014**	**0.014**	**0.009**	**0.007**
	(3.16)* **	**(3.00)*** **	**(2.50)** **	**(1.79)***
PACQ* pre-TFP	**-0.035**	**-0.058**	**-0.021**	**-0.039**
	(1.54)	(2.46)**	(1.25)	(2.23)**
Constant	-0.079	-0.027	-0.075	-0.078
	(4.77)***	(2.17)**	(11.97)***	(2.73)***
Observations	2314	2314	2314	2314
R-squared	0.05	0.08	0.11	0.17

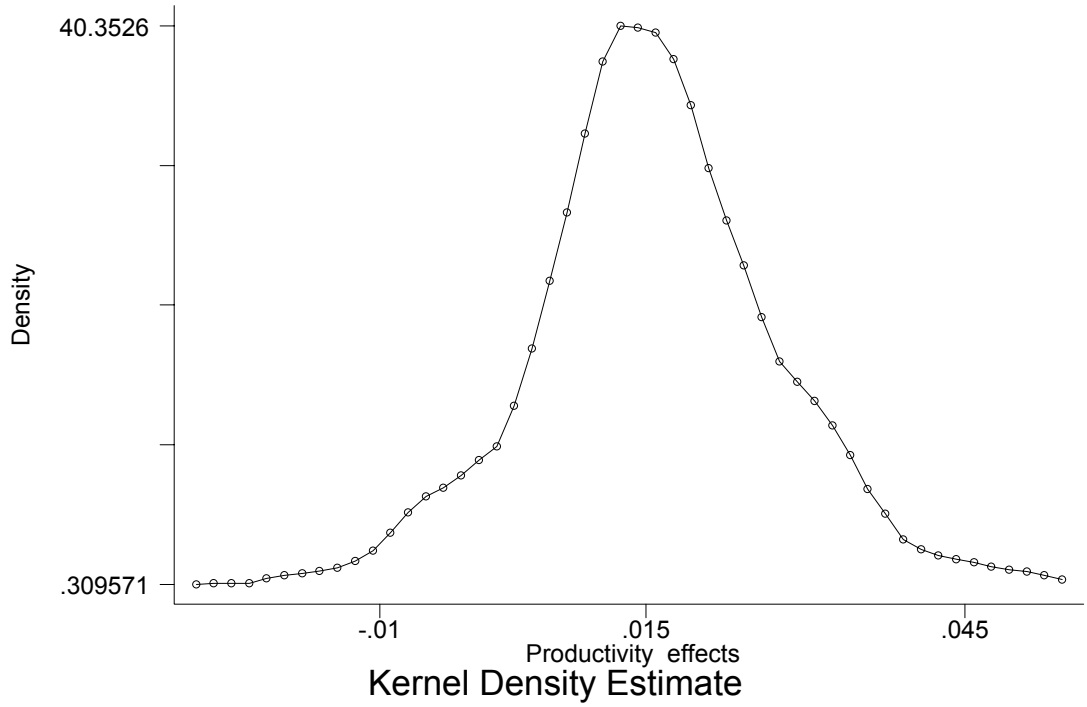
Notes:

(i) Heteroskedasticity and serial correlation robust t-statistics in parentheses

(ii) * significant at 10%; ** significant at 5%; *** significant at1%

(iii) All specifications include year dummies

Figure 1: Kernel density estimates of the productivity effects of foreign acquisitions on domestic exporters



Appendix

To compute productivity levels the index number approach was chosen as suggested by Diewert (1987) reviewing different methodologies to calculate productivity. The chosen method allows to eschew the difficulties involved in estimating flexible production functions and to obtain transitive comparisons among the productivity of firms in a multilateral setting.

The particular index used is a Tornqvist-type index. This index was first introduced by Tornqvist (1936) to make binary comparisons (i.e. comparison between two entities) and was subsequently used as output, input and productivity index. Two main advantages of the binary Torniqvist index are that it is superlative and transitive. Transitivity is one of the desiderable properties set by Fisher (1927) index numbers should respect. Diewert (1976) introduced the concept of superlative index numbers, which are those that can be directly derived from flexible functional forms. The binary Torniqvist index is superlative since it can be derived from a translog function.

In economics we are mostly interested in multilateral comparisons (i.e. comparison between more than two agents). The binary Torniqvist index could be used in this case as well to generate the set of all possible binary comparisons, but transitivity would not be necessarily respected. In time series studies to bypass this difficulty the Tornqvist index has been employed chain-linking observations so that to attain, in addition to transitive bilateral comparisons between adjacent observations, bilateral transitive comparisons between non-contiguous ones, the latter by means of intervening observations. In cross section studies this method cannot easily applied since there is not an inherent way of arranging observations.

For this reason Caves *et al* (1982a) introduced a modification of the binary Tornqvist index, which preserves its transitivity in a multilateral context even when there is not a precise ordering of the observations, as in cross section data sets. This multilateral Tornqvist index allows to construct a total factor productivity (TFP) index, which, in the one output case, is computed as the log of output of, say, plant *f* (expressed as difference of the log output of this plant from a reference point) minus the cost share weighted sum of the log of inputs

(expressed as cost share weighted difference of the log of input from a reference point). The log of output and inputs are expressed as differences from a reference point to indeed ensure transitivity among all comparisons.

The reference point is constructed as a hypothetical firm whose output and inputs levels are calculated, respectively, as the log of the geometric mean, across all firms, of the output and inputs levels. By the same token, the cost share of a certain input is computed as the arithmetic mean, across all firms, of the cost share of that input. Thus, the index can be represented by means of the following expression,

$$\ln TFP_f = \left(\ln y_f - \overline{\ln y}\right) - \frac{1}{2}\sum_{i=1}^{n}\left(s_{if} - \overline{s_i}\right)\left(\ln x_{if} - \overline{\ln x_i}\right)$$

$$\overline{\ln y} = \frac{1}{m}\sum_{f=1}^{m}\ln y_f \qquad \overline{\ln x_i} = \frac{1}{m}\sum_{f=1}^{m}\ln x_{if} \qquad \text{and} \qquad \overline{s_i} = \frac{1}{m}\sum_{f=1}^{m}s_{if}$$

$f = 1,2,3,...m$ firms; $i = 1,2,3,...n$ inputs

The terms with an upper bar represent the log of the output, inputs and their cost share of the reference firm. It is worth stressing that this reference point is not chosen arbitrarily. Indeed, it descends from the fact that the multilateral Tornqvist index ideated by Caves *et al* (1982a) compares the productivity of firm *f* with respect not to another single firm, but with respect all the other firms. This comparison is conducted subtracting the mean across all firms of their productivity, in log, from the productivity, in log, of firm *f*. Assuming a translog functional form it is possible to show that the mean of the logarithmic productivity across all firms is equal to the productivity of the reference firm (Caves *et al* 1982a).

The above index has been extended by Good, *et al* (1997) to suit panel data set, which feature both time series and cross section characteristics. In this situation both the chaining and the reference firm approaches have appealing facets. The authors proposed to construct a hypothetical firm for each cross section and to chain-link it over time as in time series studies. The index above then becomes

$$\ln TFP_{ft} = \left(\ln y_{ft} - \overline{\ln y_t}\right) - \frac{1}{2}\sum_{i=1}^{n}\left(s_{ift} - \overline{s_{it}}\right)\left(\ln x_{ift} - \overline{\ln x_{it}}\right) +$$

$$+\sum_{s=2}^{t}\left(\overline{\ln y_s}-\overline{\ln y_{s-1}}\right)-\sum_{s=2}^{t}\sum_{i=1}^{n}\frac{1}{2}\left(\overline{s_{is}}-\overline{s_{is-1}}\right)\left(\overline{\ln x_{is}}-\overline{\ln x_{is-1}}\right)$$

The first part of this index is equal to the Caves *et al* (1982) index. The second part, instead, allows to chain the reference firm through time.

In this study the above index has been used to calculate the productivity level of each firm for each year and its yearly productivity growth rates. The inputs used are labour, material and capital. The labour factor is measured as the total number of workers employed by the firm and its cost as the total wage bill. The cost of material is the cost of production of goods sold. The capital is the fixed capital stock. Due to the lack of reliable measure of the user-cost of capital its expenditure share was calculated assuming constant return to scale so that it can be computed as one minus the cost-share of the other inputs.